

WHAT IS CLAIMED IS:

1. An ink jet recording apparatus comprising a record head mounted on a carriage and reciprocated in a width direction of record paper, and a sub-tank mounted on the carriage together with  
5 the record head for receiving replenishment with ink via an ink replenishment passage from an ink cartridge forming a main tank and supplying ink to the record head, wherein air pressure generated by an air pressurizing pump is applied to the ink cartridge, and the sub-tank is replenished with ink from the ink  
10 cartridge by the action of the air pressure, the recording apparatus further comprising:

a pressure regulation valve, provided to an air flow passage from the air pressurizing pump to the ink cartridge, the valve being opened upon reception of a predetermined or more air pressure  
15 for maintaining air pressure in the air flow passage within a predetermined range; and

a pressure detector, provided to the air flow passage, for receiving the air pressure and detecting a pressure state, wherein driving of the air pressurizing pump is controlled  
20 based on output of the pressure detector.

2. An ink jet recording apparatus comprising a record head mounted on a carriage and reciprocated in a width direction of record paper, and a sub-tank mounted on the carriage together with

the record head for receiving replenishment with ink via an ink replenishment passage from an ink cartridge forming a main tank and supplying ink to the record head, wherein air pressure generated by an air pressurizing pump is applied to the ink 5 cartridge, and the sub-tank is replenished with ink from the ink cartridge by the action of the air pressure, the recording apparatus further comprising:

a cartridge holder to which the ink cartridge detachably is mounted; ;

10 a cover member provided to the cartridge holder, the cover member being opened to enable attachment and detachment of the ink cartridge to and from the cartridge holder; and  
an atmosphere release system, which opens an air flow passage from the air pressurizing pump to the ink cartridge into the 15 atmosphere as the cover member is opened.

3. The ink jet recording apparatus as claimed in claim 2, wherein the ink replenishment passage from the ink cartridge to the sub-tank includes a flexible ink replenishment tube.

4. The ink jet recording apparatus as claimed in claim 2, 20 wherein the ink cartridge has an hermetic outer shell storing therein an ink pack of a flexible material in which ink is sealingly accommodated, and wherein the air pressure generated by the air pressurizing pump is applied to a space formed between an outer

shell constituent member of the ink cartridge and the ink pack.

5. The ink jet recording apparatus as claimed in claim 2,  
wherein an ink replenishment valve is provided to the ink  
replenishment passage between the ink cartridge and the sub-tank,  
5 and opened or closed by a control signal generated by an ink amount  
detection system for detecting an amount of ink in the sub-tank.

6. The ink jet recording apparatus as claimed in claim 2,  
wherein the cartridge holder is adapted to detachably mount a  
plurality of the ink cartridges sealingly storing ink of  
10 respective types to be ejected from the record head, and wherein  
air pressure generated by the one air pressurizing pump is applied  
via the air flow passage to each of the ink cartridges mounted  
to the cartridge holder.

7. The ink jet recording apparatus as claimed in claim 2,  
15 wherein the cartridge holder comprises an electric switch for  
detecting a state in which the cover member is open, and an on-off  
valve unit forming the atmosphere release system is opened based  
on operation of the electric switch.

8. The ink jet recording apparatus as claimed in claim 7,  
20 wherein a diaphragm valve is provided to the on-off valve unit  
and is opened or closed by a drive system driven based on the  
operation of the electric switch.

9. The ink jet recording apparatus as claimed in claim 7,

wherein the drive means is includes an electromagnetic plunger.

10. The ink jet recording apparatus as claimed in claim 9 wherein a drive force of the electromagnetic plunger acts on one end part of a drive lever rotatable about a support shaft, wherein  
5 a spring member for urging the drive lever in a direction opposite from a rotation direction of the drive lever in a drive state of the electromagnetic plunger is provided to the other end part of the drive lever, and wherein a drive shaft for supporting the diaphragm valve in the on-off valve unit is joined to a part of  
10 the drive lever between the one end part of the drive lever and the support shaft, and wherein the drive shaft opens the diaphragm valve by the urging force of the spring member when the electromagnetic plunger is non-energized.

11. The ink jet recording apparatus as claimed in claim 2,  
15 wherein the atmosphere release system also serves as a pressure regulating valve for releasing pressure when the air pressure pressurized by the air pressurizing pump reaches a predetermined or more pressure for maintaining the air pressure applied to the ink cartridge in a predetermined range.

20 12. The ink jet recording apparatus as claimed in claim 2, wherein driving of the air pressurizing pump is stopped in association with opening of the cover member.

13. An ink jet recording apparatus comprising a record head

mounted on a carriage and reciprocated in a width direction of record paper, and a sub-tank mounted on the carriage together with the record head for receiving replenishment with ink via an ink replenishment passage from a main tank, and supplying ink to the  
5 record head, wherein air pressure generated by an air pressurizing pump is applied to the main tank, and the sub-tank is replenished with ink from the main tank by the action of the air pressure, the recording apparatus further comprising:

an on-off valve unit having a valve member provided to an  
10 air flow passage from the air pressurizing pump to the main tank and opened under a given or more air pressure for maintaining the air pressure in the air flow passage within a predetermined range; and

15 a drive system capable of forcibly opening the valve member in the on-off valve unit, thereby releasing a pressurization state of the air pressurizing pump.

14. The ink jet recording apparatus as claimed in claim 13, wherein the ink replenishment passage from the main tank to the sub-tank includes a flexible ink replenishment tube.

20 15. The ink jet recording apparatus as claimed in claim 13, wherein an ink replenishment valve is provided to the ink replenishment passage between the main tank and the sub-tank, and is opened or closed by a control signal generated by an ink amount

detection system for detecting an amount of ink in the sub-tank.

16. The ink jet recording apparatus as claimed in claim 13,  
wherein the main tank has a hermetic outer shell storing an ink  
pack of a flexible material in which ink is sealingly accommodated,  
5 and wherein the air pressure generated by the air pressurizing  
pump is applied to a space formed by an outer shell constituent  
member of the ink cartridge and the ink pack.

17. The ink jet recording apparatus as claimed in claim 13,  
wherein a plurality of main tanks for sealingly storing ink of  
10 respective types to be ejected from the record head are provided,  
and wherein air pressure generated by the one air pressurizing  
pump is applied to each of the main tanks.

18. The ink jet recording apparatus as claimed in claim 13,  
wherein a drive shaft capable of moving the valve member is  
15 provided to the on-off valve unit, and is driven by the drive system  
to open the valve member.

19. The ink jet recording apparatus as claimed in claim 18,  
wherein the drive force of the drive system is transmitted to a  
drive lever rotatable about a support shaft, and is transmitted  
20 via the drive lever to the drive shaft in the on-off valve unit.

20. The ink jet recording apparatus as claimed in claim 13,  
wherein the drive system includes an electromagnetic plunger.

21. The ink jet recording apparatus as claimed in claim 20,

wherein the valve member in the on-off valve unit is opened by the drive force of the electromagnetic plunger generated when the electromagnetic plunger is energized, thereby releasing the pressurization state.

5        22. The ink jet recording apparatus as claimed in claim 20, wherein the drive force of the electromagnetic plunger acts on one end part of a drive lever rotatable about a support shaft, wherein a spring member for urging the drive lever in an opposite direction to the rotation direction of the drive lever in the drive  
10      state of the electromagnetic plunger is provided to the other end part of the drive lever, and wherein a drive shaft in the on-off valve unit is joined to a part of the drive lever between the one end part of the drive lever and the support shaft, and opens the valve member in the on-off valve unit by the urging force of  
15      the spring member when the electromagnetic plunger is non-energized, thereby releasing the pressurization state.

23. The ink jet recording apparatus as claimed in claim 13, wherein a ventilation hole for communicating with the atmosphere is formed in the on-off valve unit, and is closed by the elastic  
20      force of the valve member for maintaining a closed valve state.

24. The ink jet recording apparatus as claimed in claim 13, wherein the on-off valve unit is formed with a ventilation hole for communicating with the atmosphere, and has a spring member

for urging the valve member toward the ventilation hole, and the ventilation hole is closed by the urging force of the spring member for maintaining a closed valve state.

25. The ink jet recording apparatus as claimed in claim 13,  
5 wherein the on-off valve unit is formed with a ventilation hole  
for communicating with the atmosphere and has a spring member for  
urging the valve member toward the ventilation hole, and the  
ventilation hole is closed by the elastic force of the valve member  
and the urging force of the spring member for maintaining a closed  
10 valve state.

26. The ink jet recording apparatus as claimed in claim 13,  
wherein the valve member is a diaphragm valve.

27. The ink jet recording apparatus as claimed in claim 26,  
wherein the diaphragm valve has a peripheral portion clamped at  
15 a joint part between upper and lower cases forming an outer shell  
of the on-off valve unit, wherein one of the upper and lower cases  
and the diaphragm valve form an air chamber in a hermetic state,  
and wherein the diaphragm valve opens or closes a ventilation hole  
communicating with the air chamber.

20 28. An ink jet recording apparatus, wherein pressurized air  
generated by an air pressurizing pump is applied to a main tank  
storing ink and a record head mounted on a carriage is replenished  
with ink from the main tank by the action of the pressurized air,

the recording apparatus comprising:

a pressure detector, provided to an air flow passage between the air pressurizing pump and the main tank, for detecting pressure of the pressurized air, wherein driving of the air pressurizing  
5 pump is controlled based on a control signal generated according to the pressure detected by the pressure detector, the pressure detector including:

a diaphragm displaced upon reception of the air pressure of the pressurized air; and

10 an output generation system for generating a control signal based on the displacement amount of the diaphragm.

29. The ink jet recording apparatus as claimed in claim 28, wherein the main tank has a hermetic outer shell storing an ink pack formed of a flexible material in which ink is sealingly  
15 accommodated, and wherein the pressurized air generated by the air pressurizing pump is applied to a pressure chamber formed between an outer shell component of the main tank and the ink pack.

30. The ink jet recording apparatus as claimed in claim 28, wherein a sub-tank mounted on the carriage is replenished with  
20 ink via an ink replenishment passage from the main tank, and ink is supplied from the sub-tank to the record head mounted on the carriage.

31. The ink jet recording apparatus as claimed in claim 30,

wherein the ink replenishment passage from the main tank to the sub-tank includes a flexible ink replenishment tube.

32. The ink jet recording apparatus as claimed in claim 28, wherein the output generation system includes a movable member  
5 which advances or retreats by the displacement of the diaphragm, and a photosensor having a light source and a light receiving element disposed to cross a move path of the movable member and generating the control signal based on output of the light receiving element forming a part of the photosensor.

10 33. The ink jet recording apparatus as claimed in claim 28, wherein the output generation system includes a movable member which advances or retreats by displacement of the diaphragm, and a photosensor having a light source for projecting light onto a move path of the movable member and a light receiving element for 15 receiving reflected light of the light source based on a movement of the movable member and generating the control signal based on output of the light receiving element forming a part of the photosensor.

34. The ink jet recording apparatus as claimed in claim 32  
20 or 33, wherein the diaphragm is formed of an elastic material and the movable member advances or retreats based on displacement of the diaphragm depending on balance of the air pressure received by the diaphragm and the restoration force of the diaphragm.

35. The ink jet recording apparatus as claimed in claim 34, wherein the movable member is formed with a step part for preventing the diaphragm from being excessively displaced by the air pressure.

5       36. The ink jet recording apparatus as claimed in claim 32 or 33, further comprising a spring member for urging the diaphragm in a restoration direction of the diaphragm, wherein the movable member advances or retreats based on the displacement of the diaphragm depending on balance of the air pressure received by  
10      the diaphragm, the restoration force of the diaphragm, and the urging force of the spring member.

15      37. The ink jet recording apparatus as claimed in claim 36, further comprising a stopper member for receiving the urging force of the spring member and inhibiting excessive displacement of the diaphragm.

38. The ink jet recording apparatus as claimed in claim 32 or 33, wherein the movable member is molded integrally with the diaphragm.

20      39. The ink jet recording apparatus as claimed in claim 28, wherein the diaphragm is formed of rubber.

40. The ink jet recording apparatus as claimed in claim 28, wherein the diaphragm is formed of rubber and cloth.

41. The ink jet recording apparatus as claimed in claim 28,

wherein the diaphragm is arranged to close an opening part of a case, and a space portion for receiving the air pressure from the air pressurizing pump is formed in the case.

42. The ink jet recording apparatus as claimed in claim 41,  
5 wherein the case is formed with a pressurized air introduction connection tube for introducing the pressurized air from the air pressurizing pump into the space portion, and a plurality of pressurized air distribution connection tubes for distributing the pressurized air to respective main tank from the space portion.

10       43. An ink jet recording apparatus, wherein pressurized air generated by an air pressurizing pump is applied to a main tank storing ink, and ink is supplied from the main tank to a record head mounted on a carriage by the action of the pressurized air, the recording apparatus comprising:

15       a pressure detector, provided to an air flow passage between the air pressurizing pump and the main tank, for detecting pressure of the pressurized air; and

20       a control system for driving the air pressurizing pump if a pressure detection value obtained by the pressure detector does not reach a predetermined pressure value, and stopping the air pressurizing pump after expiration of a predetermined time if the pressure detection value obtained by the pressure detector reaches the predetermined pressure value.

44. The ink jet recording apparatus as claimed in claim 43,  
further comprising a pressure release valve opened for regulating  
pressure if the pressure in the air flow passage between the air  
pressurizing pump and the main tank is a pressure higher than the  
5 predetermined pressure detected by the pressure detector, wherein  
if the pressure detection value obtained by the pressure detector  
reaches the predetermined value, the control system stops the air  
pressurizing pump after expiration of time required for the  
pressure release valve to be opened.

10 45. The ink jet recording apparatus as claimed in claim 43,  
wherein a sub-tank mounted on the carriage is replenished with  
ink via an ink replenishment passage from the main tank, and ink  
is supplied from the sub-tank to the record head mounted on the  
carriage.

15 46. The ink jet recording apparatus as claimed in claim 45,  
wherein the ink replenishment passage from the main tank to the  
sub-tank includes a flexible ink replenishment tube.

47. The ink jet recording apparatus as claimed in claim 43,  
wherein the main tank has an hermetic outer shell storing an ink  
20 pack of a flexible material in which ink is sealingly stored, and  
wherein the pressurized air generated by the air pressurizing pump  
is applied to a pressure chamber formed by an outer shell component  
of the main tank and the ink pack.

48. The ink jet recording apparatus as claimed in claim 43,  
wherein the pressure detector includes a diaphragm displaced upon  
reception of the air pressure of the pressurized air, and an output  
generation system for generating a control signal based on the  
5 displacement amount of the diaphragm.

49. The ink jet recording apparatus as claimed in claim 48,  
wherein the output generation system comprises a movable member  
advancing or retreating by displacement of the diaphragm, and a  
photosensor having a light source and a light receiving element  
10 disposed so as to cross a move path of the movable member and  
generating the control signal based on output of the light  
receiving element forming a part of the photosensor.

50. The ink jet recording apparatus as claimed in claim 48,  
wherein the output generation system includes a movable member  
15 advancing or retreating by displacement of the diaphragm and a  
photosensor having a light source for projecting light onto a move  
path of the movable member and a light receiving element for  
receiving reflected light of the light source based on a movement  
of the movable member and generating the control signal based on  
20 output of the light receiving element forming a part of the  
photosensor.

51. The ink jet recording apparatus as claimed in claim 49  
or 50, wherein the diaphragm is formed of an elastic material,

and the movable member advances or retreats based on the displacement of the diaphragm depending on balance of the air pressure received by the diaphragm and the restoration force of the diaphragm.

5        52. The ink jet recording apparatus as claimed in claim 51, further comprising a spring member for urging the diaphragm in a restoration direction of the diaphragm, wherein the movable member advances or retreats based on the displacement of the diaphragm depending on balance of the air pressure received by  
10      the diaphragm, the restoration force of the diaphragm, and the urging force of the spring member.

15      53. The ink jet recording apparatus as claimed in claim 52, further comprising a stopper member for receiving the urging force of the spring member and inhibiting excessive displacement of the diaphragm.

54. The ink jet recording apparatus as claimed in claim 51, wherein the movable member is formed with a step part for preventing the diaphragm from being excessively displaced by the air pressure.

20      55. The ink jet recording apparatus as claimed in claim 48, wherein the diaphragm is formed of rubber.

56. The ink jet recording apparatus as claimed in claim 48, wherein the diaphragm is formed of rubber and cloth.

57. The ink jet recording apparatus as claimed in claim 48, wherein the diaphragm is arranged to close an opening part of a case, and a space portion for receiving the air pressure from the air pressurizing pump is formed in the case.

5 58. The ink jet recording apparatus as claimed in claim 57, wherein the case is formed with a pressurized air introduction connection tube for introducing the pressurized air from the air pressurizing pump into the space portion, and a plurality of pressurized air distribution connection tubes for distributing  
10 the pressurized air to respective main tanks from the space portion.

59. An ink jet recording apparatus, wherein pressurized air generated by an air pressurizing pump is applied to a main tank storing ink, and a record head mounted on a carriage is replenished  
15 with ink from the main tank by the action of the pressurized air, and wherein a pressure detector including a diaphragm displaced upon reception of the pressurized air and a signal generation system for generating a pressure sense signal based on the displacement amount of the diaphragm is provided to an air flow  
20 passage between the air pressurizing pump and the main tank, wherein:

the diaphragm is formed of a material having such a varying hardness changed as to be high in a low temperature state and low

in a high temperature state, or a material having such a varying volume as to contract in a low temperature state and expand in a high temperature state, or a movable member for mechanically joining the diaphragm and the signal generation system is formed 5 of a material having such a varying size in a moving direction as to contract in a low temperature state and expand in a high temperature state; and

driving of the air pressurizing pump is controlled based on the pressure sense signal generated by the signal generation 10 system.

60. The ink jet recording apparatus as claimed in claim 59, wherein a temperature dependency characteristic of the value of pressure to generate the pressure sense signal by the signal generation system is almost equal to a temperature dependency 15 characteristic in the viscosity of ink with which the record head is replenished from the main tank.

61. The ink jet recording apparatus as claimed in claim 59, wherein a temperature dependency characteristic of the value of pressure to generate the pressure sense signal by the signal 20 generation system is almost equal to a temperature dependency characteristic in the pressure loss on a replenishment passage of ink with which the record head is replenished from the main tank.

62. The ink jet recording apparatus as claimed in claim 59,  
wherein a sub-tank mounted on the carriage is replenished with  
ink via an ink replenishment passage from the main tank, and ink  
is supplied from the sub-tank to the record head mounted on the  
5 carriage.

63. The ink jet recording apparatus as claimed in claim 62,  
wherein the ink replenishment passage from the main tank to the  
sub-tank includes a flexible ink replenishment tube.

64. The ink jet recording apparatus as claimed in claim 59,  
10 wherein the signal generation system includes a movable member  
advancing or retreating by the displacement of the diaphragm, and  
a photosensor having a light source and a light receiving element  
disposed so as to cross a move path of the movable member and  
generating the pressure sense signal based on output of the light  
15 receiving element forming a part of the photosensor.

65. The ink jet recording apparatus as claimed in claim 28,  
wherein the signal generation system comprises a movable member  
advancing or retreating by the displacement of the diaphragm, and  
a photosensor having a light source for projecting light onto a  
20 move path of the movable member and a light receiving element for  
receiving reflected light of the light source based on a movement  
of the moving member and generating the pressure sense signal based  
on output of the light receiving element forming a part of the

photosensor.

66. The ink jet recording apparatus as claimed in claim 64 or 65, wherein the diaphragm is formed of an elastic material and the movable member advances or retreats based on the displacement  
5 of the diaphragm depending on balance of the air pressure received by the diaphragm and the restoration force of the diaphragm.

67. The ink jet recording apparatus as claimed in claim 66, wherein the movable member is formed with a step part for preventing the diaphragm from being excessively displaced by the  
10 air pressure.

68. The ink jet recording apparatus as claimed in claim 66, further comprising a spring member for urging the diaphragm in a restoration direction of the diaphragm, wherein the moving member advances or retreats based on the displacement of the  
15 diaphragm depending on balance of the air pressure received by the diaphragm, the restoration force of the diaphragm, and the urging force of the spring member.

69. The ink jet recording apparatus as claimed in claim 68, further comprising a stopper member for receiving the urging force  
20 of the spring member and inhibiting excessive displacement of the diaphragm.

70. The ink jet recording apparatus as claimed in claim 59, wherein the diaphragm is formed of rubber.

71. The ink jet recording apparatus as claimed in claim 59,  
wherein the diaphragm is formed of rubber and cloth.

72. The ink jet recording apparatus as claimed in claim 70  
or 71, wherein the rubber of the diaphragm is NBR and has a rubber  
5 hardness of 40 to 60 degrees.